Simulation of glaciogenic tsunamis generated by the Wilkins Ice Shelf collapse of 2008

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The 28-29 February, 2008, break-up of a part of the Wilkins Ice Shelf, Antarctica, exemplifies the now-familiar pattern of "explosive" ice-shelf break-up thought to be a consequence of environmental warming in the Antarctic Peninsula region. Key aspects of this "explosive pattern" to be explained by theories of ice-shelf dynamics include:

- The abrupt, near simultaneous onset of iceberg calving across a large-scale stretch of ice front
- High outward drift velocity (~0.3 m/s) of a leading "phalanx" of tabular icebergs that formerly comprised the seaward edge of the ice shelf prior to the break-up
- Efficient "surface coverage" of the ocean surface between the intact ice shelf and the leading phalanx of tabular icebergs by small icebergs, capsized icebergs and dismembered tabular icebergs (small irregular pieces)
- Extremely large gravitational potential energy conversion rates, e.g., up to 3 x 10^{10} W, by the "inverted submarine landslide" process over short periods of time (e.g., hours to days) in the absence of significant ice deformation
- The apparent lack of proximal iceberg-calving triggers (e.g., strong atmospheric storms in the local environment) at the time of break-up onset
- The capacity for enabling conditions (e.g., presence of melt-water induced "hydrostatic fracture") to make possible multiple break-up events (e.g., a second pulse of the Wilkins Ice Shelf break-up in late May, 2008) distributed through various seasons.

I examine the basic dynamic features of ice-shelf/ocean-wave interaction (including ice-shelf sources of ocean waves) that may explain the above aspects of the explosive ice-shelf disintegration process. Ice-shelf generated surface-gravity waves and flexural-gravity waves associated with initial calving at an arbitrary "seed location" produce stress perturbations capable of stimulating calving on the entire ice front. Waves generated by parting detachment rifts, iceberg capsize and break-up stimulate the "inverted submarine landslide" process, whereby ice shelf of thickness H_i is converted to a field of iceberg rubble of thickness $H_f<H_i$. Gravitational potential energy released by this conversion is primarily dissipated by surface gravity wave radiation through the ice rubble in the region of ocean surface located between the advancing phalanx of tabular icebergs and the active calving front of the still-intact ice shelf. I conclude by describing how field research and remote sensing can be used to test the various conjectures about ice-shelf/wave interaction that appear to be at play during ice-shelf disintegration.